

INVITATION TO BID

Addendum # 1



Department Of Executive Services
Finance and Business Operations Division
Procurement and Contract Services Section
206-684-1681 TTY Relay: 711

ADDENDUM DATE: July 19, 2006

ITB Title: 500 kW Electrical Transformer for Traction Power Service

ITB Number: ITB 06-080-ART

Revised Due Date/Time: August 10, 2006 - 2:00 P.M.

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This addendum is issued to revise ITB 06-080 ART, advertised July 13, 2006 as follows:

1. The Bid Opening Date has been delayed one week From August 3, 2006 to August 10, 2006 at 2:00 p.m. exactly.
2. Major changes have been made to Section 5 - Technical Specifications – Section 16325R Transformer
 - **Delete this entire Section and Replace with the following:**

SECTION 5 - Technical Specifications – Section 16325R Transformer (Revised)

5.1 PART 1 – GENERAL

5.1.1 SCOPE

This Specification Section covers the manufacture and testing of a replacement rectifier transformer for an existing 500kW traction power substation. The application of the transformer is at less then 500 feet above sea level.

5.1.2 APPLICABLE STANDARDS

- A. Pertinent provisions of the following listed standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of those Specifications to the extent required:
 1. American National Standards Institute (ANSI):
 - C34.2 Practices and Requirements for Semiconductor Power Rectifiers
 - C57.12.01 General Requirements for Dry-Type Distribution and Power Transformer
 - C57.12.91 Test Code for Dry-Type Distribution and Power Transformers
 2. Electronic Industries Association (EIA):
 - RS-282 Recommended Standards for Silicon Rectifier Diodes and Stacks
 3. National Electrical Manufacturer's Association (NEMA):
 - RI-9 Silicon Rectifier Units for Transportation Power Supplies
 - SG 5 Power Switchgear Assemblies
 - TR-1 Transformers, Regulators and Reactors

5.1.3 SUBMITTALS

A. General

1. The Contractor shall submit drawings, technical data, catalog cuts, calculations, test documents, monthly progress reports/updates, in English, to King County for approval. The submittals shall provide evidence that the Contractor has complied with the Contract Documents. All submittals shall be accompanied by King County's Form #1300-A, Submittal Transmittal Form. A copy of this form is available from the Project Representative.
2. A registered Professional Engineer shall sign submittals, including drawings, technical data, calculations and test documents.
3. Each submittal shall indicate the corresponding Article or Section number of the Contract Document under which it is required. Each drawing prepared specifically for this contract by the Contractor shall be D-size (22 inches by 34 inches), and shall have its own drawing number and title clearly identified in the title block. Part numbers and names shall be used to identify components. All submittals shall have a revision number and date.
4. King County intends to review and approve submittals for design and compliance with the contract within 20 calendar days of receipt of submittals. In the event the submittals require changes or further explanation, one marked print of each submittal will be returned to the Contractor for corrections and shall be resubmitted. Delays due to resubmittal of disapproved submittals shall be the full responsibility of the Contractor and will not provide a basis for an extension of time.

B. Submittals:

Within 30 calendar days after Award of Contract, the Contractor shall submit the complete submittal package for approval. Submittal package shall indicate equipment electrical data and physical dimensions. Submittal shall also indicate equipment storage and operation environmental requirements as well as handling instructions, connection procedure, torque values, etc.

C. Test Documents test plan, procedures, and reports for tests specified in the Section shall conform to the requirements herein. Six copies of each test document shall be submitted.

1. Test Plan: The test plan shall be used as a controlling document for all tests, and shall include the following information:
 - a. Title of each test with reference to the respective Article or Paragraph number in the technical specifications.
 - b. Organization performing each test.
 - c. Test location.
 - d. Submittal date of each test procedure, test report, and certified test document.
 - e. Starting date of each test.
 - f. Completion date of each test.
2. Test Procedures: The Contractor shall develop detailed test procedures for each test. Test procedures shall be submitted to King County for review and comment 30 calendar days prior to performing each test. Test procedures shall be stapled or bound in volumes. Each procedure shall be individually numbered in a logical sequence with all pages numbered. The first sheet of the procedure shall contain the title, date, and name of individuals who

prepared and approved the procedure. Test procedures will not be required if such procedures are described in ANSI, IEEE, or NEMA standards, or standards approved by King County and two copies of the standard are submitted with the related test. Each set of procedures shall include the following information:

- a. Title of test.
 - b. Test objectives.
 - c. Test location and date of test.
 - d. Equipment and instrumentation with the accuracies and calibration data.
 - e. Test criteria including test setup with circuit diagrams and test sequence.
 - f. Step-by-step procedure for performing the test.
 - g. Test criteria including data evaluation procedures.
 - h. Test data requirements including forms and format for recording data.
 - i. Primary and supporting test agency.
3. Test Reports: The Contractor shall prepare test reports for each test to document test results. Each test report shall be stapled or bound in volumes, with pages individually numbered in a logical sequence with all pages numbered. The first sheet of the report shall contain the title, date, and name of individuals who prepared and approved the test report. Each test report shall include the following information.
- a. Title of test.
 - b. Test objectives.
 - c. Summary and conclusions.
 - d. Location and date of test.
 - e. Results including tables, curves, photographs, and any additional test data required to support the test results.
 - f. Descriptions of all failures and modifications, including reasons for such failures, and modifications and names of individuals approving such modifications.
 - g. Abbreviations and references.
 - h. Names, titles and signatures of test participants and witnesses.

5.2 PART 2 - PRODUCTS

5.2.1 GENERAL

- A. The transformer shall consist of a single three-phase dry-type transformer, without enclosure, as shown on the Drawings. The transformer shall be complete with auxiliaries, bus connections, and all necessary hardware, wiring and devices. Except as otherwise specified, the transformer shall conform to ANSI C57.12.01, and C57.12.91, and NEMA RI 9, SG 5, and TR 1.
- B. Application: The transformer shall convert 26.4 kV, 60 Hz, effectively grounded, 3 phase, 3 conductor primary power to 518 volts AC at 100 percent of full load. The transformer shall receive AC power from the existing 27 kV AC buswork. The transformer secondary shall connect to existing buswork extending to a six-pulse silicon rectifier.

- C. Ratings: The transformer rectifier unit is rated 500 kW, measured at 672V DC at the output terminals. The existing transformer is rated at 667kVA. The rectifier is 6 pulse, double-way, in accordance with ANSI C34.2, Circuit No. 24. Other technical characteristics shall be:
1. Loading Condition: The transformer rectifier units shall be designed to meet the duty cycle specified in NEMA RI-9 for heavy traction power service, defined as follows: The transformer rectifier units shall be capable of operating continuously at 100 percent of rated load amperes until constant temperatures have been reached by all parts of the transformer rectifier unit. After constant full load temperatures are reached, the transformer rectifier unit shall be capable of operating at 150 percent of rated load amperes for 2 hours or at 300 percent of rated load amperes for 1 minute. At any time that the full load rated temperatures are not exceeded (at the start of an overload), the transformer rectifier unit shall be capable of operating at the specified overload ratings.
 2. Efficiency: The overall efficiency of the transformer rectifier assembly shall be greater than 98 percent at its continuous rating.
 3. Power Factor: The displacement power factor of the transformer rectifier assembly shall be 0.95 or greater from 25 percent to full load at rated AC voltage.
 4. Regulation: The voltage on the DC bus shall be within the following limits with the nominal AC voltage maintained at the transformer primary and the transformer set at the rated voltage tap:

Output DC Voltage (Volts)

<u>Output Current</u>	<u>Maximum</u>	<u>Nominal</u>	<u>Minimum</u>
No load	700		
100% full load	675	672	669
150% full load	662	658	654
300% full load	624	616	608

- D. Transients: Existing lightning arrestors are provided against transient surge voltages on the high voltage side of the transformer and the DC side of the rectifier. Fuses are provided on the primary side of the transformer and an AC air circuit breaker is provided on the secondary side.
- E. Short Circuit Ratings: The transformer shall be designed to withstand a full short circuit with shorted low-voltage terminals, and rated voltage on the high-voltage terminals, in accordance with ANSI C57.12.01. The duration of the short-circuit current shall be at least one second.
- F. Sound Levels: The audible sound level for the transformer, housed in its enclosure with all panels bolted, measured 6 feet away from the assembly, within the substation enclosure, shall not exceed 55 dBA at 100 % load.

5.2.2 RECTIFIER TRANSFORMER

- A. Type and Rating: Rectifier transformer shall be dry type (Class AA) construction and shall be installed by King County electricians in the existing transformer compartment of the substation. Transformer shall conform to the dimensions of the existing transformer exactly. All existing electrical and structural attachment points shall be utilized and the transformer shall connect to all wiring and buswork without modification. The transformer shall be self-cooled, 26.4 kV primary, 3 phase, 60 Hz, suitable for indoor service at the duty cycles described herein.

- B. Windings: High- and low-voltage windings shall be copper. The high-voltage winding shall be grounded-wye connected, 150 kV BIL. The low-voltage winding shall be ungrounded wye-connected. Winding insulation shall be designed to ensure adequate performance under the specified conditions for a design life of forty years.
- C. Temperature Limits: The transformer average temperature rise shall not exceed 115 deg. C when the transformer is operated at full nameplate rating, in the specified ambient temperature. The transformer shall not suffer any deterioration or loss of life when operated at the specified duty cycle.
- D. Impedance: In order to properly coordinate with the characteristics of the existing rectifier and relaying, the transformer shall have an impedance of 7.08%.
- E. Taps: The high-voltage windings shall have four full capacity taps, two above rated voltage in 2.5 percent steps and two below rated voltage in 2.5 percent steps, for deenergized tap changing. Tap changing shall be by movable links. Tap connections shall be brought out and rigidly supported on a terminal board located on the transformer. Tap connections shall be clearly marked so that the tap selected is clearly identifiable. The tap-changing links shall be securely bolted in position. The design of links and connectors shall make it impossible to short out sections of windings, or to select taps outside the prescribed range, by incorrectly connecting the links.
- F. Terminations: The rectifier transformer shall be bus connected to the AC switchgear on the high voltage side and to the rectifier on the low-voltage side using the existing bus connections.
- G. Accessories: The transformer shall be provided with a well in each coil set for installation of the existing winding temperature detection device.
- H. Construction: The transformer shall be so designed that parts, which require maintenance, are readily accessible.
 - 1. Transformer Enclosure: The existing transformer enclosure provides openings for adequate airflow. Dimensions of the enclosure and positions of the transformer mounting points and bus connections are shown on the drawings, which follow this section. The transformer supplier shall provide the total weight of the transformer during the submittal process so that adequacy of the supporting structure can be verified. The transformer mounting shall be designed to minimize undue vibration.
 - 2. Base Construction: Base construction shall be designed for rolling or skidding in any direction. Provision shall be made for pulling along the centerlines perpendicular to each side. Jacking facilities shall be provided at each of the four corners of the base to permit insertion of rollers between floor and base. Base construction shall firmly secure the core to prevent relative motion of the core during shipment, handling, or seismic shock.
 - 3. Lifting Hooks: Lifting hooks or eyes shall be provided on the transformer to facilitate lifting the unit.
- I. Nameplate: The rectifier transformer shall be provided with a corrosion-resistant metal nameplate, marked in accordance with ANSI C57.18.

5.2.3 RECTIFIER

- A. General: The rectifier is existing and is not provided or modified by this contract. The rectifier is natural (convection) cooled, with 6 pulse rectification in accordance with Circuit No. 24 of ANSI C.34.2, suitable for the duty cycle specified.

- B. Construction: Physical isolation is provided between the rectifier section enclosure and the transformer enclosure as shown on the Drawings, which follow this section.
- C. Surge Protection: The rectifier unit is equipped with voltage-surge suppressors to limit the reverse voltage across the silicon diodes within the peak reverse voltage rating of the diode, irrespective of whether the voltage transient appears in the alternating current or direct current power circuits. The voltage-surge suppressors consist of a resistor-capacitor network, and are connected across each leg of the circuit to reduce the magnitude of the line voltage surge.
- D. Diodes:
 - 1. General: Silicon diodes, hermetically sealed.
 - 2. Fuse Protection: Each diode is protected by a current-limiting fuse. The fuse will disconnect the diode in case of failure and protect the other components of the rectifier. Fuses are sized to withstand all external DC faults or loading conditions. Operation of fuse provides visual indication in addition to diode failure alarm. A diode failure device is provided to detect loss of one or more diodes. Failure of one diode initiates annunciation, and failure of more than one diode initiates tripping of the appropriate rectifier lockout relay (86R).
 - 3. Temperature Indication: A temperature indicator is provided to detect diode heat sink temperatures. The temperature indicator is provided with two-stage contact. The pickup point of each stage is adjustable, and is factory set so that, upon excessive temperature increase, the device shall initiate annunciation. With a greater temperature increase, the device initiates annunciation with normally open contact and trips the lockout relay included in the AC switchgear.

5.3 PART 3 – EXECUTION

5.3.1 GENERAL

- A. The transformer shall be produced by a manufacturer regularly engaged in the production of traction power rectifier transformers. The supplier shall provide specific industry references for similar transformer projects.

5.3.2 TESTING

- A. Transformer testing shall be performed in accordance with IEEE Standard C57.12.91. The impulse test may be admitted. As a part of the equipment submittal, the supplier shall provide a complete, written test program showing the proposed location and composition of the test program, to enable King County and utility personnel to witness all testing. Complete, written documentation shall be furnished indicating acceptable completion of all tests. King County or its agents reserve the right to witness all tests whether conducted by the Contractor, by an independent agency, or by the Contractor's suppliers. Supplier shall provide sufficient notice of the time and location of the tests. If King County determines not to witness a test or tests, test reports shall nevertheless be submitted to King County for approval. The reports shall be signed by all responsible witnessing parties.
- B. Responsibility: The Contractor shall be responsible for all factory and field tests performed under this Contract. The Contractor shall furnish all test instruments for both factory and field tests described herein, and other equipment and materials necessary for performing all factory tests required prior to shipment. All test equipment shall be calibrated within 30 calendar days prior to use, unless otherwise approved by King County. Proof of calibration shall be submitted with all test reports. Should there be any loss of equipment or damage to such equipment as a result of

tests, the Contractor shall be fully responsible for replacing the damaged equipment or repairing such equipment. Replacement of damaged equipment shall include all costs, including but not limited to, removing damaged equipment, furnishing, transporting, and installing replacement equipment.

- C. Rejection and retesting: Equipment, which fails to meet test specifications and the specified ratings, shall be replaced with new equipment that conforms to the Contract requirements. Modifications to rejected equipment may be made only with the approval of King County. Rejected equipment shall be retested after reworking or replacement. The entire cost of the modifications or the new unit shall be borne by the Contractor, including retesting and the cost of witnessing retesting, including that of King County. If modifications or changes affect any drawings, diagrams, or other documents previously submitted to and accepted by King County, revised drawings or diagrams shall be submitted for King County's approval showing proposed changes before changes or modifications are made on the equipment. Modifications or changes, which do not warrant revision of a drawing, shall still be furnished to King County with notice of the retest schedule. If it is not practicable to rework rejected equipment, new equipment shall be manufactured. The requirement for drawings and design calculations of the original unit shall be applicable to the new unit. Failure of equipment to meet the test specifications shall not be the cause for an extension of time of delivery.
- D. Test reports: The Contractor shall provide and complete test reports prepared in accordance with Paragraph 1.10.E of Section 16010. The forms shall be prepared by the Contractor and approved by King County for each test. Failure to complete test reports properly may delay successive testing and will be considered sufficient cause to delay progress payments. After each test report is signed by King County or its agents, the Contractor shall submit copies of the report to King County for filing and distribution.
- E. Test requirements:
 - 1. Design Tests: The following factory tests shall be performed on the transformer. This test will not be waived except as specified below.
 - a. Short circuit tests, as described in ANSI C57.12.91, shall be made to evaluate fully the capability of all windings. At least one extreme of the tap range shall be used in the tests. Faults shall be applied on the secondary terminals. Tests shall be performed for each secondary winding.
 - b. Dielectric impulse with positive polarity waves as described in NEMA RI 9. The impulse tests shall include one application of a reduced full wave, and two applications of a chopped wave, followed by one application of a full wave. These tests shall be performed after the short circuit tests.
 - c. Resistance measurement of all windings on rated voltage connections and on all taps.
 - d. Impedance and load losses at rated current on rated voltage connections and on all taps.
 - 2. Production Tests: The following tests, described in NEMA RI 9, shall be performed on all rectifier transformers:
 - a. Resistance measurements of all windings on rated voltage connections and on all taps.
 - b. Ratio tests on the rated voltage connections and on all taps.
 - c. Polarity and phase relation tests on the rated voltage connections.

- d. Impedance and load losses at rated current on the rated voltage connections and on all taps, including excitation loss and excitation current.
- e. Excitation loss and excitation current rated voltage on the rated voltage connections.
- f. Applied potential and induced potential.
- g. Partial discharge tests as follows:
 - (1.) The transformer shall be subjected to an induced voltage of 1.5 times the rated voltage at a frequency between 100 Hz and 400 Hz.
 - (2.) Partial discharge measurements shall be performed with a selected instrument operating at a frequency of 1.9 MHz.
 - (3.) Partial discharge extinction level shall be reached at an induced voltage higher than 1.2 times rated line to line voltage.
 - (4.) Partial discharge extinction level will be considered to have been reached when the reading at 1.9 MHz is less than 10 microvolts or 13 picocoulombs.

End Of Section

Note: The bid opening date has been delayed for one week to August 10, 2006 – 2:00 PM.